



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/733,845	12/11/2003	Peter Andrews	5308-299	9026
7590 11/26/2004			EXAMINER	
Myers Bigel Sibley & Sajovec, P.A.			PERT, EVAN T	
P.O. Box 37428			ART UNIT	
Raleigh, NC 27627			PAPER NUMBER	
			2829	

DATE MAILED: 11/26/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/733,845

Applicant(s)

ANDREWS ET AL.

Examiner

Evan Pert

Art Unit

2829

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 December 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-59 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5, 11-16, 20-23, 32-35, 40-43, 45-48, 55, 58 and 59 is/are rejected.
- 7) ☒ Claim(s) 6-10, 17-19, 24-31, 36-39, 44, 49-54, 56 and 57 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 March 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>1203, 0804</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Objections*

1. Claims 1-59 are objected to under 37 CFR 1.71 because applicant unclearly claims a potentially broader "thermally weakened zone (TWZ) in a substrate" to mean "thermally weakened zone (TWZ) in a substrate, the TWZ *substantially formed by material conversion rather than by material ablation.*"

While applicant may be his or her own lexicographer in a patent application, in the instant case, applicant describes as prior art (p. 2) the act of scribing a trench with a laser by ablation, and then breaking. This type of dicing using a laser, often referred to as "laser scribing" (US 3,626,141 and US 3,816,700), inherently creates a "thermally weakened zone" because the laser-formed scribe line is a "weakened zone" (i.e. break line), caused by ablation of material due to *thermal* and optical treatment (per IEEE article by Lizotte).

Appropriate correction is required.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-4, 11-14, 20-22, 33-35, 40-41, 45-47 and 58 are rejected under 35 U.S.C. 102(b) as being anticipated by Goto et al. (US 5,185,295).

Regarding claim 1, a TWZ of substrate (11) material is formed (at arrow 10) between devices (e.g. left and right devices seen in cover figure) by a laser focused between major surfaces of the substrate [col. 4, lines 26-34], defining a "break line" (i.e. a weaker "separation" line that is later broken apart by chemical etching per col. 2).

Regarding claim 2, "separating" is considered as a kind of "breaking."

Regarding claims 3 and 4, the TWZ certainly has a depth into the connecting portion of more than 50% and more than 95%, because the TWZ extends across substantially the entire thickness of the connecting portions.

Regarding claim 11, the thickness of substrate 11 is much greater than the thickness of TWZ (i.e. " $\Delta W$ " in Fig. 2).

Regarding claims 12 and 14, the two rectifier devices in the cover figure joined by the TWZ at arrow 10, each have multiple device layers occupying both sides of the substrate (i.e. 1, 2, 3, 4).

Regarding claim 13, the rectifier devices are formed before the laser making a TWZ at arrow 10 (see step at Fig. 1, which temporally precedes step at Fig. 2).

Regarding claims 20-22, the claimed contacts correspond to the four contacts shown in the cover figure (i.e. nickel 3, with eutectic metal solder layer 4).

Regarding claims 33-34, the substrate assembly depicted in Fig. 2, prior to breaking apart by chemical etching as shown in Fig. 3, has TWZs 22 between devices, wherein the TWZ is thicker than 1/2 the thickness of the connecting portion because the TWZ is all of the connecting portion (i.e. > 95%).

Regarding claim 35, each of the 1st and 2nd opposing surfaces of the substrate is "*substantially* non-surface ablated" because the  $\Delta W$  area of TWZ 22 is far less than the surface area of the substrate as a whole.

Regarding claims 40 and 41, the device layers include 1 and 2, and the layers are separated into discrete devices by chemically breaking at TWZs 22.

Regarding claims 45-47, contacts of the rectifier devices that correspond to the claimed contacts are seen as formed from layers 3 and 4 wherein layer 4 is solder (i.e. a eutectic metal).

Regarding claim 58, the substrate assembly seen in Fig. 2 corresponds to claim element a), prior to chemically breaking into discrete devices as seen in Fig. 3, and has TWZs 22, corresponding to claim element b), rendering a plurality of devices separable along break lines of TWZs 22 (i.e. claim element d), with the depth (i.e. thickness of substrate 11) much greater than the width of TWZ 22 (i.e. " $\Delta W$ "), such that element c) of the claim is anticipated.

4. Claims 1-5, 11-14, 20-21, 33-35, 40-41, 45-46 and 58 are rejected under 35 U.S.C. 102(b) as being anticipated by Gates et al. (US 3,970,819).

Regarding claim 1, a laser 21 is focused within substrate 10 between surfaces 10a and 10b, forming TWZs 22 between discrete devices defining a "break line" (e.g. col. 4, lines 37-41).

Regarding claim 2, breaking by roller is performed to break at the TWZs (col. 2, lines 22-26 and 57-61) to form first and second dice.

Regarding claims 3 and 4, the TWZs 22 certainly have a depth into the connecting portion of more than 50% and more than 95%, because the TWZ extends across substantially the entire thickness of the connecting portions.

Regarding claims 5 and 35, there is substantially no "ablation" because the column 22 is a result of material conversion, not ablation [cols. 3-4].

Regarding claim 11, the thickness of substrate 10 is significantly greater than the width of TWZ (compare .002 diameter beam creating TWZ 22 to .0155 inch thick wafer).

Regarding claims 12 and 14, the two devices in the cover figure joined by the TWZ 22 to be broken by roller, each have device layers as claimed (i.e. 13).

Regarding claim 13, the devices are formed first (i.e. they're formed already in Fig. 1), like any dicing operation that comes after devices are formed in a wafer as a whole.

Regarding claims 20-21 and 45-46, the claimed contacts correspond to solder balls 17 (wherein "solder" is a "eutectic metal").

Regarding claims 33-34, the substrate assembly depicted in Fig. 3, prior to breaking apart by mechanical roller as shown in Fig. 3, has TWZs 22 between devices, wherein the TWZs' depth is thicker than 1/2 the thickness of the connecting portion because the TWZs extend through all of the connecting portions (i.e. > 95%).

Regarding claims 40 and 41, a device layer is seen as 13, with first and second device portions (i.e. left and right of TWZ 22), the assembly separated into first and second devices along break lines defined by the TWZs (e.g. Fig. 4).

Regarding claim 58, claim element a) corresponds to substrate 10, element b) corresponds to TWZs 22, element c) is anticipated since the TWZ column is much narrower than it is tall, and element d) corresponds to separation by roller seen in Fig. 4.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 15, 16, 23, 32, 42-43, 48, 55 and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gates et al. or Goto et al., as applied to claims 1, 12, 14, 33, 41 and 58 above, and further in view of Han et al. (IEEE 1994)

Both Gates et al. and Goto et al. are silent about the devices separated from wafer being "LEDs" (i.e. claims 15 and 42), "laser diodes" (i.e. claims 16 and 43), that the substrate is formed of SiC (i.e. claims 32, 55 and 59), or that at least one device layer includes a Group III nitride (i.e. claims 23 and 48).

Both Gates et al. and Goto et al. do explain that their techniques of dividing discrete devices from a wafer are applicable to generic semiconductor devices, both giving the example of a "diode."

Han et al. explain that blue/green lasers are needed in general "in order to meet the growing needs of our information generation," and that in order to make a laser diode in this color, prior art "approaches include" the use of "SiC" and "Group III nitrides" [p. 18].

It would have been obvious to one of ordinary skill in the art at the time of the claimed invention to apply the wafer dividing method of either Goto et al. or Gates et al., to the manufacture of blue/green laser diodes formed in plurality as part of a wafer, to reap the benefits of the wafer dividing methods explained by each of Goto et al. and Gates et al..

One of ordinary skill in art would have been motivated to manufacture blue/green laser diodes to "meet the growing needs" explained by Han et al., and would be motivated to adopt "SiC" and "Group III nitride" as an "alternate approach" to achieving a blue/green laser diode (i.e. a type of light emitting diode).

***Allowable Subject Matter***

6. Claims 56-57 are objected to for the informality noted under item 1 above, but are otherwise allowable.

7. Claims 6-10, 17-19, 24-31, 36-39, 44 and 49-54 are objected to for informalities noted in this office action, including dependency on rejected base claims.

8. The following is a statement of reasons for the indication of allowable subject matter:

Regarding claims 6-10, 17-19, 24-31, 36-39, 44, 49-54 and 56-57, the prior art does not disclose applicant's invention characterized by a combination of both a trench and connecting material at scribe lines, wherein connecting material at scribe lines is (made) mechanically weaker (i.e. mechanically forcibly breakable) compared to substrate material, by localized thermal treatment with a laser causing material conversion to a weaker material.

### ***Conclusion***

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

#### **Non-patent Literature**

Lizotte ("Laser Dicing of Chip Scale and Silicon Wafer packages", IEEE 2003) is cited for disclosing the scientific principles of "thermal processes" and "photo ablative processes" that necessarily constitute a laser beam's interaction with a wafer during laser dicing.

#### **US Patents**

US 6,653,210 discloses wafer separation by a laser that forms a crack, and follows with a second laser that propagates the crack, but does not disclose conversion to a TWZ that could be in a wafer to be broken at a later time.

US 6,211,488 discloses wafer separation using coolant to propagate a crack following heating by laser, but does not disclose a TWZ that could be in a wafer to be broken at a later time.

US 5,543,365 discloses converted zones of "streaked polysilicon" formed by laser, but these are not TWZs that "form a break line."

US 4,355,457 discloses a wafer separation method using a trench followed by cutting along the bottom of the trench, but doesn't disclose a "TWZ."

US 3,816,700 discloses "laser scribing" [admitted prior art per p. 2].

US 3,626,141 discloses "laser scribing" [admitted prior art per p. 2].

Art Unit: 2829

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Evan Pert whose telephone number is 571-272-1969.

The examiner can normally be reached on M-F (7:30AM-3:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Tokar can be reached on 571-272-1812. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ETP  
November 17, 2004

  
**EVAN PERT**  
**PRIMARY EXAMINER**